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Is there a relationship between knee osteoarthritis and osteoporosis?

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Abstract

Aim: Osteoarthritis (OA) and osteoporosis (OP) are two metabolic bone diseases associated with old age. Recently, the hypothesis that there may be a relationship between OP and OA and that the degree of OA will change with the degree of OP has been emphasized. In this cross-sectional study, the relationship between knee OA and bone mineral density (BMD) in female patients was investigated.

Material and Methods: In this cross-sectional study of 324 patients with knee pain and radiological diagnosis of knee OA, the severity of knee OA was evaluated according to Kellgren-Lawrence (K-L) radiographic criteria and joint space distance (JSD). BMD of the femur and lumbar spine was measured by dual-energy X-ray absorptiometry (DXA). K-L grade and the relationship between JSD and BMD were examined.

Results: T scores of femoral neck, femoral trochanter, femoral intertrochanter, total hip were highest in K-L stage 2 group and lowest in K-L stage 4 group. Femoral T scores were found to be significantly lower in BMD in the C-L stage 3 and 4 group compared to the C-L stage 1 and 2 group ($p < 0.001$). No significant correlation was found between K-L stage and L1-L4 T score.

Discussion: Although there is an inverse relationship between OP and the presence of knee OA, the relationship between the two is not linear. In order to evaluate patients better, it is necessary to know the relationship between the two diseases.

Keywords

Osteoarthritis, Osteoporosis, Bone Mineral Density

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Introduction

Osteoarthritis (OA) and osteoporosis (OP) are two metabolic diseases that increase in frequency with age, are very common in society, negatively affect the patient's quality of life and cause functional disability in the patient. Osteoporosis is a skeletal disease characterized by decreased bone mineral density (BMD), causing deterioration in bone microarchitecture and reduction in bone mass [1]. Osteoarthritis, on the other hand, is a degenerative skeletal disease that can affect all joints, characterized by the deterioration of articular cartilage and new bone formation [2, 3]. The relationship between these two diseases is quite complex in terms of bone loss, new bone formation, fracture risk, mechanical loading and systemic causes. Although recent publications are trying to explain the relationship between the two, this relationship has not been clearly demonstrated and is still controversial [4, 5]. Bone turnover plays a very important role in the common pathophysiology of OA and OP diseases. It has been reported that there is a relationship between high bone turnover and the progression of OA levels in osteoporosis. In some studies, it has been found that patients with severe knee OA have higher bone turnover biomarkers and lower bone mineral density [6]. In rabbit experiments to explain the relationship between OP and OA; It has been emphasized that the deterioration in the microarchitecture of the subchondral bone caused by osteoporosis increases the severity of osteoarthritis. There are cross-sectional and experimental studies examining the relationship between BMD and knee OA over the Kellgren-Lawrence (K-L) grade. In a study on women; BMD scores were found to be higher in the C-L grade 2 and above group compared to the group without OA [5, 7]. In some studies, it has been shown that high BMD is protective in terms of OA severity [8, 9].

In this study, it was aimed to examine the relationship between radiological knee OA severity and ipsilateral proximal femur and L1-L4 lumbar spine T score in postmenopausal women.

Material and Methods

This cross-sectional study included 324 postmenopausal women patients who applied to the Physical Medicine and Rehabilitation outpatient clinic with knee pain between January 2020 and January 2021 and were diagnosed with knee OA according to American Collage of Rheumatology (ACR) criteria [10].

Demographic data such as age and BMI (kg/m2) were recorded. Radiologic staging of knee OA by Kellgren Lawrence (K-L) and BMD measurement by dual-energy X-ray absorptiometry (DXA) [11]. were done for each patient [12]. Femoral neck, thoracantary femur, interthoracantary femur, total hip and L1-L4 lumbar spine total T scores of all participating patients in the study were measured by DXA. The severity of knee OA was evaluated according to K-L radiographic criteria and joint space distance (JSD). JSD was measured by anteroposterior (AP) knee radiography. K-L grade and the relationship between JSD and BMD were investigated.

Inclusion criteria were to be ages between 50-75 postmenopausal women and OA staging of K-L between 1 to 4 for knee OA. Exclusion criteria; K-L grade 0, had a surgical procedure related to the knee, valgus alignment (≥3° valgus), inflammatory joint disease, congenital knee joint deformity, endocrinological disease, and disease affecting bone metabolism were not included in the study. Diagnoses of lumbar spondylosis and coxarthrosis, which may affect DXA measurement results, were excluded.

Assessment Radiographic Knee OA

Radiologic evaluation of osteoarthritis was performed according to K-L staging. K-Lstaging; Anteroposterior and lateral radiographs of both knees taken while standing were evaluated (at 30° flexion). Knee OA staging was classified radiographically by a physiatrist according to the K-L criteria: These stages are as follows: Stage 0: Normal; Stage I: Suspected osteophytes, normal joint spacing; Stage 2: Definite osteophyte, suspicious narrowing of joint space; Stage 3: Moderately numerous osteophytes, definite narrowing of joint space, mild sclerosis; Stage 4: Large osteophytes, significant sclerosis and cysts, severe joint space narrowing, definite deformity of the bone ends [13].

Measure of the Joint Space Distance

Knee joint spacing was measured as recommended in the literature. Patients were asked to slightly bend their knees at 30 degrees of flexion, with their weight evenly distributed on both knees. The patella was positioned at the lower end of the femur. The beam was standardized 2.5 cm below the apex of the patella. The mechanical axis of the knee was recorded as the line formed between the center of the femoral head, the medial plateau of the tibia and the ankle joint. The X-ray was applied parallel to the tibial plateau. JSD was measured as the maximum height in the middle of the medial and lateral compartments of each knee. In other words, the gap in the

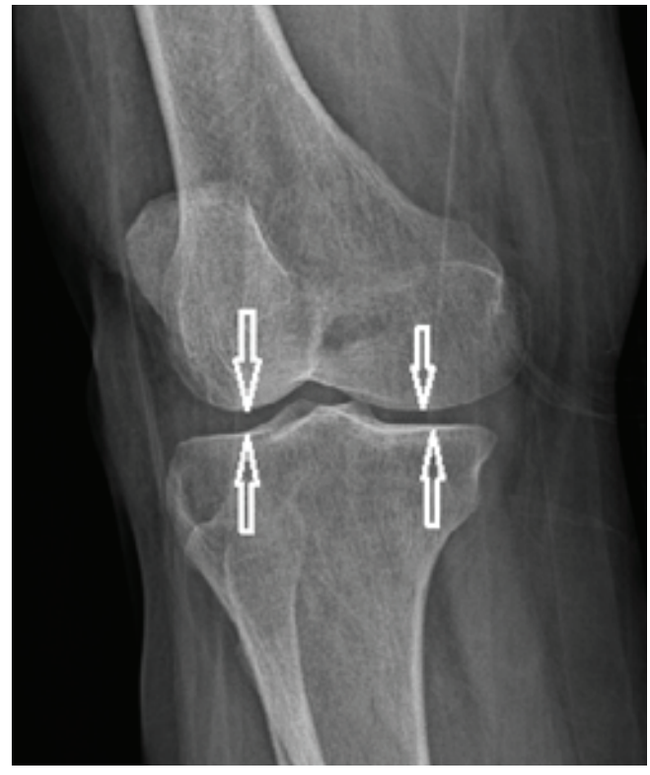

Figure 1. Joint Space Distance (JSD): Shows reference points for measuring medial and lateral tibio-femoral joint space widths. (arrows)

radiolucent area between the radiopaque edges of the tibio-femoral joint surfaces was measured (Figure 1) [14].

BMD Measurement

DXA measurements were done by Hologic Horizon Wi S/N 201290 at the education and research hospital radiology unit. T-scores below -2.5 for lumber total, femur neck and femur total, femur inerthoracanteric BMDs were accepted as OP referring to World Health Organization (WHO) classification criteria. The BMD value of the discrete/crushed vertebrae corpus was subtracted from the value of total lumbar BMD for not causing a wrong decision. According to the WHO classification, T scores between -1 and -2.5 were considered osteopenia, and those below -2.5 were considered OP [15].

Statistical Analysis

SPSS 20 program was used for statistical analysis and p value <0.05 was considered statistically significant. Correlation analysis was performed to analyze the relationship between JSN and T scores (femoral neck, femoral trochanter, femoral intertrochanter, total hip, and spine) in knee AP images. Analysis of Covariance (ANCOVA) was used to evaluate the relationship between T scores in K-L stage category groups.

Ethical Approval

This study was approved by the ethics committee of Harran University, Faculty of Medicine (Date: 2021-11-15, No: HRU/21.20.12). All participants provided written informed consent for participation in the survey and the use of their data for research purposes.

Results

The mean age of 342 postmenopozal women patients participating in the study was 66.47±8.10 (50–73) years, and the mean BMI was 28.07±3.04(20.49–39.43) kg/m2. The mean value of the JSD was measured as 2.05±1.65(0–7.40) mm. According to K-L stage, 52 (15.20%) of the patients were K-L stage 1, 38 (11.11%) K-L stage 2, 89 (26.02%) K-L stage 3 and 163 (47.66%) K-L stage was 4. Demographic and clinical data of the patients are given in A significant correlation was found between JSD and T scores of the femoral neck, femoral trochanter, femoral intertrochanter, and total hip (p=0.042, r=0.152; p=0.000, r=0.262; p=0.000, r=0.305; p=0.001, r=0.230 respectively). However, no relationship was found between JSD and spinal L1-L4 T scores (p=0.181, r=0.105) (Table 2). T scores of femoral neck, femoral trochanter, femoral intertrochanter, total hip were highest in K-L stage 2 group and lowest in K-L stage 4 group. Femoral T scores were found to be significantly lower in BMD in the K-L stage 3 and 4 group compared to the K-L stage 1 and 2 group (p < 0.001). No significant correlation was found between K-L stage and spinal L1-L4 T score (Table 3).

Discussion

The relationship between OA and OP has not been clearly explained [15, 16]. Due to the factors affecting the pathophysiology of OA and OP, the extent of the relationship between the severity of OP and the degree of OA needs to be addressed from different perspectives. It is not a correct approach to evaluate and treat OA and OP diagnoses separately in clinical practice. It would be an appropriate approach to evaluate and treat both diagnoses together. We think that this study is important in terms of raising awareness on this issue.

In this cross-sectional study, there was a relationship between JSD and K-L staging and hip BMD; however, there was no correlation between spinal BMD. At the same time, it was observed that there was no linear relationship between knee OA and BMD. That is, while the hip T score was highest in patients with K-L stage 2, it was found to be the lowest in stage 4 patients. The results of this study show some similarities and

Table 1. Demographic Characteristics of the Participants (N: 342)

Characteristics		
Age (years)		66.47 ± 8.10 (50–73)
Gender (F/M)		%35,08(N:120) / %64,92 (N:222)
BMI (kg/m2)		28.07 ± 3.04 (20.49–39.43)
JSD (AP view, mm)		2.05 ± 1.65 (0–7.40)
K-L stage	1	52 (%15,20)
	2	38 (%11,11)
	3	89 (%26, 02)
	4	163 (%47, 66)

BMI:Body Mass Index, JSD: Joint Space Distance, K-L: Kellgren-Lawrence, AP: antero posterior.

Table 2. The relationship between BMD and JSD

	Femoral neck T score		Femoral trochanter T score		Femoral intertrochanter T score		Total hip T score		Lomber Spine (L1–L4) T score	
	r	p	r	p	r	p	r	p	r	p
JSD (AP view, mm)	0.152	0.042*	0.262	0.000*	0.305	0.000*	0,23	0.001*	0.105	0.181

BMD: bone mineral density, AP: anteroposterior, JSD: Joint space distance *p < 0.05.

Table 3. The relationship between Tscores and knee OA (K-L stage)

	K-L stage 1 (n:52)	K-L stage 2 (n: 38)	K-L stage 3 (n: 89)	K-L stage 4 (n: 163)	p value
Femoral neck T score	-0.42±1.04	-0.25±1.02	-0.61±1.12	-0.92±1.10	*<0.001
Femoral trochanter T score	-0.53±1.08	-0.30±1.13	-0.52±1.05	-0.87±1.14	*<0.001
Femoral intertrochanter T score	-0.32±1.08	-0.35±1.05	-0.52±1.02	-0.87±1.13	*<0.001
Total hip T score	-0.35±1.03	-0.28±1.05	-0.55±1.05	-0.85±1.12	*<0.001
Lomber Spine T score (L1–L4)	-1.15±1.12	-1.35±1.03	-1.27±1.05	-1.32±1.13	0.075

differences with previous studies.

In the Framingham study; it was found that the femoral BMD value was higher in the female patient group with knee OA compared to the group without OA. However, unlike our study, it was shown that there was no relationship between BMD and JSD [17]. There is also a study showing a negative relationship between OP density and K-L staging of OA [4].

In a study similar to ours, BMD was found to be higher in K-L stage 2 and lower in K-L stage 3 compared to K-L stage 0 in women. In the study, higher BMD levels were observed with increasing K-L stage [18]. In the study, higher BMD levels were observed as the K-L stage increased. In a study of 473 geriatric women, patients with K-L grades 1 and 2 had a higher BMD than those without OA; lower BMD was found in K-L grades 3 and 4 [19].

In a multicenter OA study, higher BMD was observed in knees without OA and was associated with increases in the degree of joint space narrowing. However, the relationship between OA progression and BMD in knees with OA was not found to be significant [20]. Contrary to all these studies, in the study conducted by Sezer et al., no statistically significant relationship was found between BMD and the degree of knee OA [21].

Similarly, in a large-scale study conducted in the Korean population, the relationship between BMD and knee OA was investigated. Consistent with our study, in knee OA (K-L grades 2, 3 and 4), femoral neck and total hip BMD decreased as K-L grade increased, while spinal BMD did not differ significantly [22].

In a study investigating the relationship between BMD and OA in postmenopausal female patients; lumbar spine BMD levels were statistically higher in the non-OA group than in the OA group. However, there was no difference between the groups in terms of femoral BMD values. As a result, it has been emphasized that OA may be protective against OP [23].

Various contributing factors such as metabolic, mechanical, genetic or endocrinological in the etiology of OA and OP reveal the complex relationship between these two diseases. It has been argued that subchondral bone density may cause progressive chondrocyte dysfunction in the early stages of cartilage destruction. Increased mechanical stress of weight-bearing cartilages with high BMD is aggravating for OA [24].

The results of this article make a clinical contribution to the literature. First of all, this is the first study in the literature to evaluate knee OA patients with both K-L stage and JSD and to examine the relationship between both and BMD.

At the same time, the higher T score in patients with mild OA in the study suggests that bone quality may be misinterpreted in this group. In OA patients, it is also a situation that we should pay attention to when treating OP; It would not be very accurate to evaluate a high T score as an indicator of good bone quality. It can be interpreted as a temporary increase in the T score due to the high amount of subchondral bone. It is important to inform patients that OP is more likely to exacerbate, as the T score decreases significantly with the progression of OA in patients with OA.

It was concluded from this study that OP should be more effectively prevented and treated in patients with early stage OA. In mild OA, BMD results may not accurately reflect bone quality, as the T-score may increase as a result of bone sclerosis. We think that a different measurement tool should be used to more accurately measure bone quality in clinical practice and more research is needed in this area.

The spine and hip, designated as standard BMD measurement sites, are affected by the subcondal bone in the knee joint, which is a load-bearing joint. Therefore, we think that knee BMD can also be deduced from hip and spine values. More patient and multicenter studies are needed on this subject. We wanted to emphasize the importance of evaluating patients with OA or OP holistically, predicting the risk of OA or OP in patients, and providing appropriate clinical treatment to prevent them in daily practice.

Limitation

This study has some limitations. First of all, the number of patients participating in the study is not sufficient. Second, comorbidities affecting BMD scores were ignored. Third, only patients with radiological OA were included in the study. Its relationship to patients with symptomatic knee pain has not been evaluated.

Conclusion

As a result, this study is an attempt to explain the relationship between OA and OP in more detail. While BMD scores were higher in mild knee OA cases, they were significantly lower in moderate and severe OA. We also hypothesized that it would be possible to deduce the bone quality of the knee from hip and spine BMD, which are the standard regions routinely used for BMD measurement. Because the hip and spine are also stimulated by load bearing similar to the subchondral bone of the knee.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or compareable ethical standards.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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